

EOS-MLS and NDACC lidar temperature comparisons over the period September 2004 – July 2006

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MLS dataset

1. Version 1.5 !
2. Each profile retrieved every 15 s, with horizontal resolution of 165 km and vertical resolution of 3 km or more

Lidar dataset

1. NDACC: Network for the Detection of Atmospheric Composition Change, 10 temperature lidars in network, 5 presented here.
2. Rayleigh and N₂ vibrational Raman backscattering by atmosphere
3. Temperature retrieved from density using 1-point tie-on at top of profile and downward integration of hydrostatic balance
4. Each profile retrieved for 2- to 6-hour integrated measurements, and 75- to 300-m vertical resolution, depending on NDACC station

Other datasets

1. NCEP operational analysis interpolated at JPL lidar location, and time of lidar measurement
2. NCEP-NCAR Re-Analysis interpolated at JPL lidar location, and time of lidar measurement
3. Hilo Radiosonde profiles within 6 hours of JPL-MLO lidar measurement

The NDACC temperature Lidar stations

JPL TMF lidar station:

- Table Mountain, California
- Latitude: 34.4°N
- Longitude: 117.7°W
- Elevation: 2285 m

JPL MLO Lidar station:

- Mauna Loa, Hawaii
- Latitude: 19.5°N
- Longitude: 204.4°W
- Elevation: 3400 m

CNRS OHP lidar station:

- Haute-Provence, France
- Latitude: 44°N
- Longitude: 6°W
- Elevation: 679 m
- PI (T): Alain Hauchecorne

Ny-Alesund lidar station (AWI):

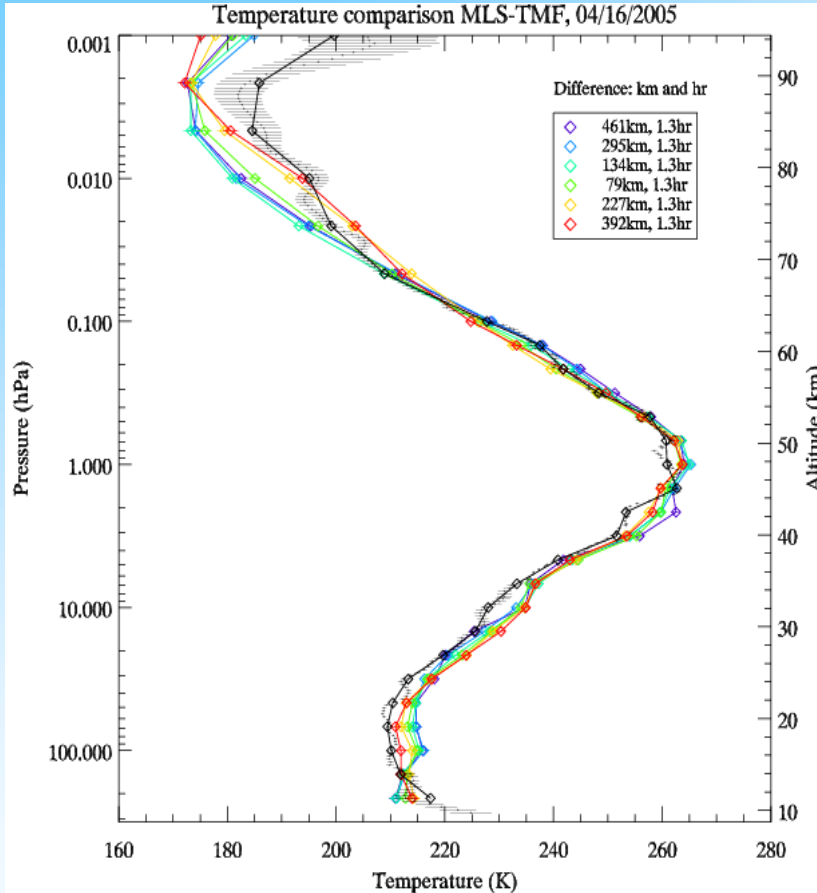
- Spitzbergen, Norway
- Latitude: 78.9°N
- Longitude: 11.9°E
- Elevation: 11 m
- PI: Peter Van der Gathen

DWD HOH lidar station

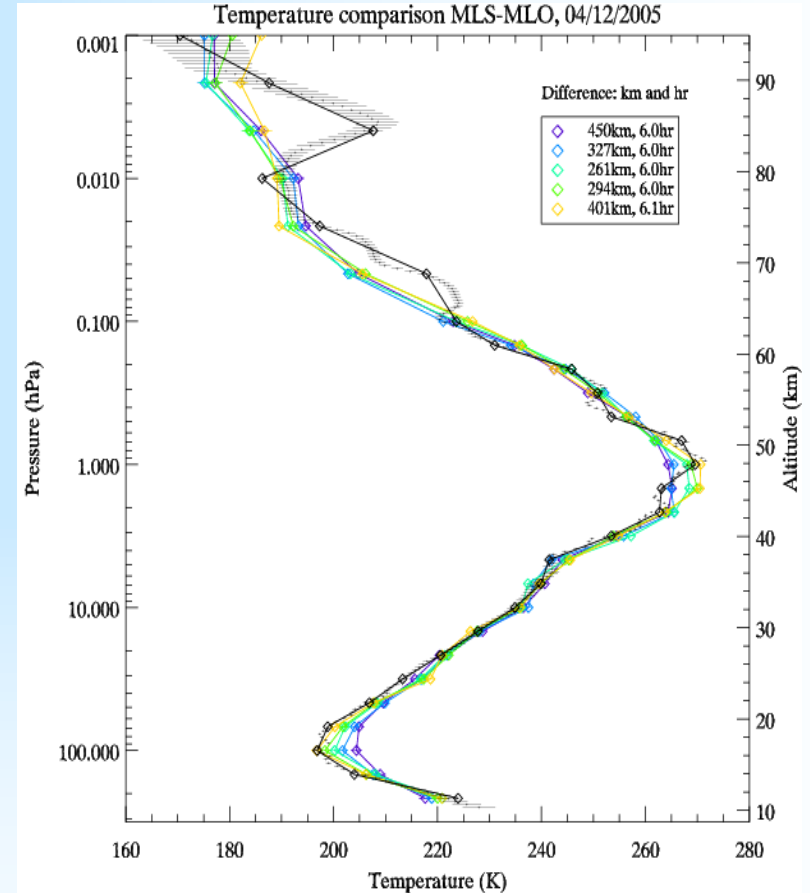
- Hohenpeissenberg, Germany
- Latitude: 47.8°N
- Longitude: 11°E
- Elevation: 1000 m
- PIs: Hans Claude/Wolfgang Steinbrecht

MLS: Individual comparisons with TMF and MLO lidars

Black: lidar profiles **Horizontal bars** = unsmoothed \pm tot. error
Solid curves = smoothed using MLS kernels



Color: MLS profiles
within \pm 6 hours and 500 km



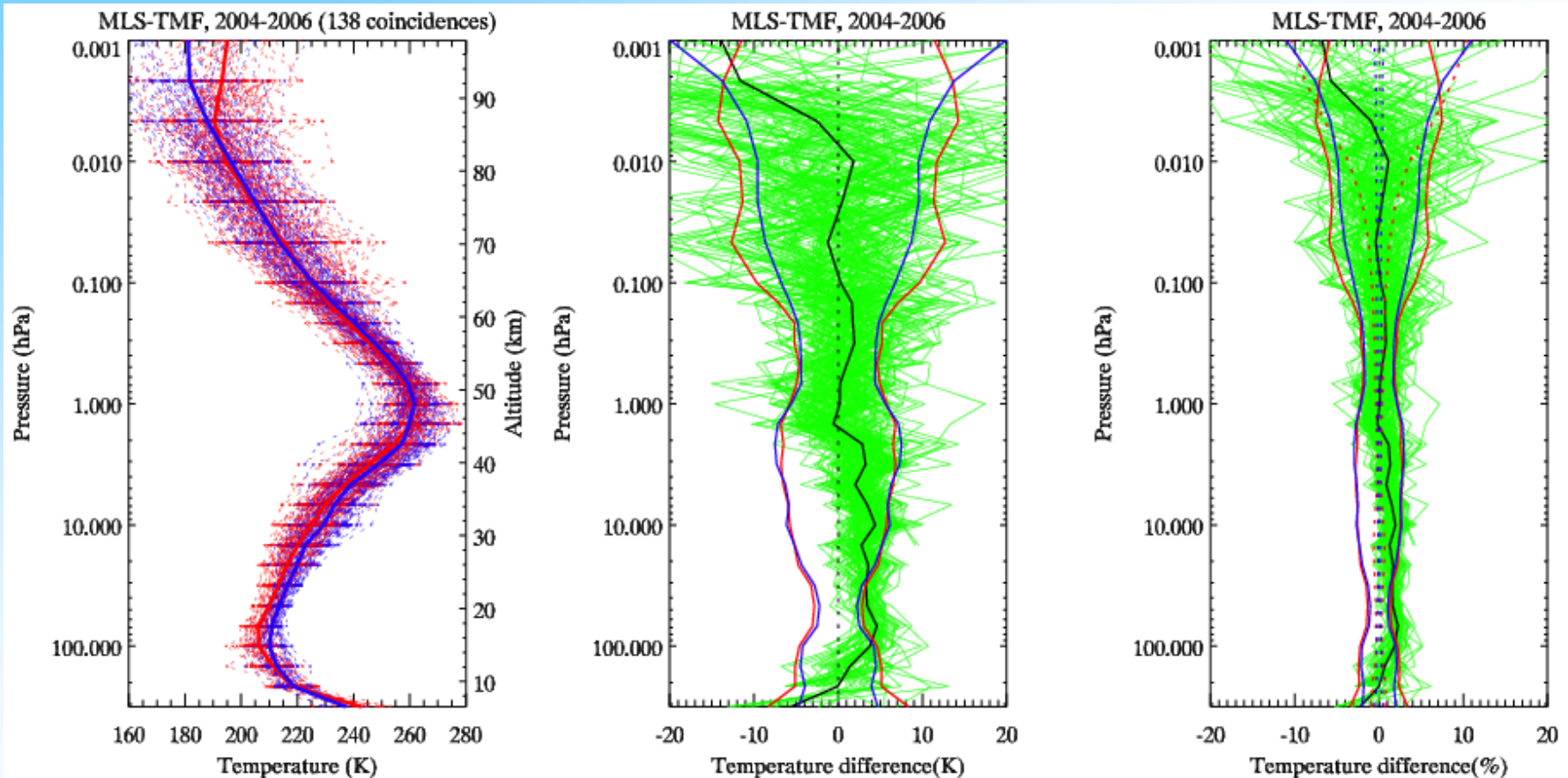
1. **MLS smooths out mesospheric temp. inversion layers**
2. **MLS systematically warmer than lidar in the stratosphere**
3. **Time coincidences with MLO not optimized**

MLS - TMF lidar (within +/- 6 hours and 400 km)

Blue: MLS
Red: lidar

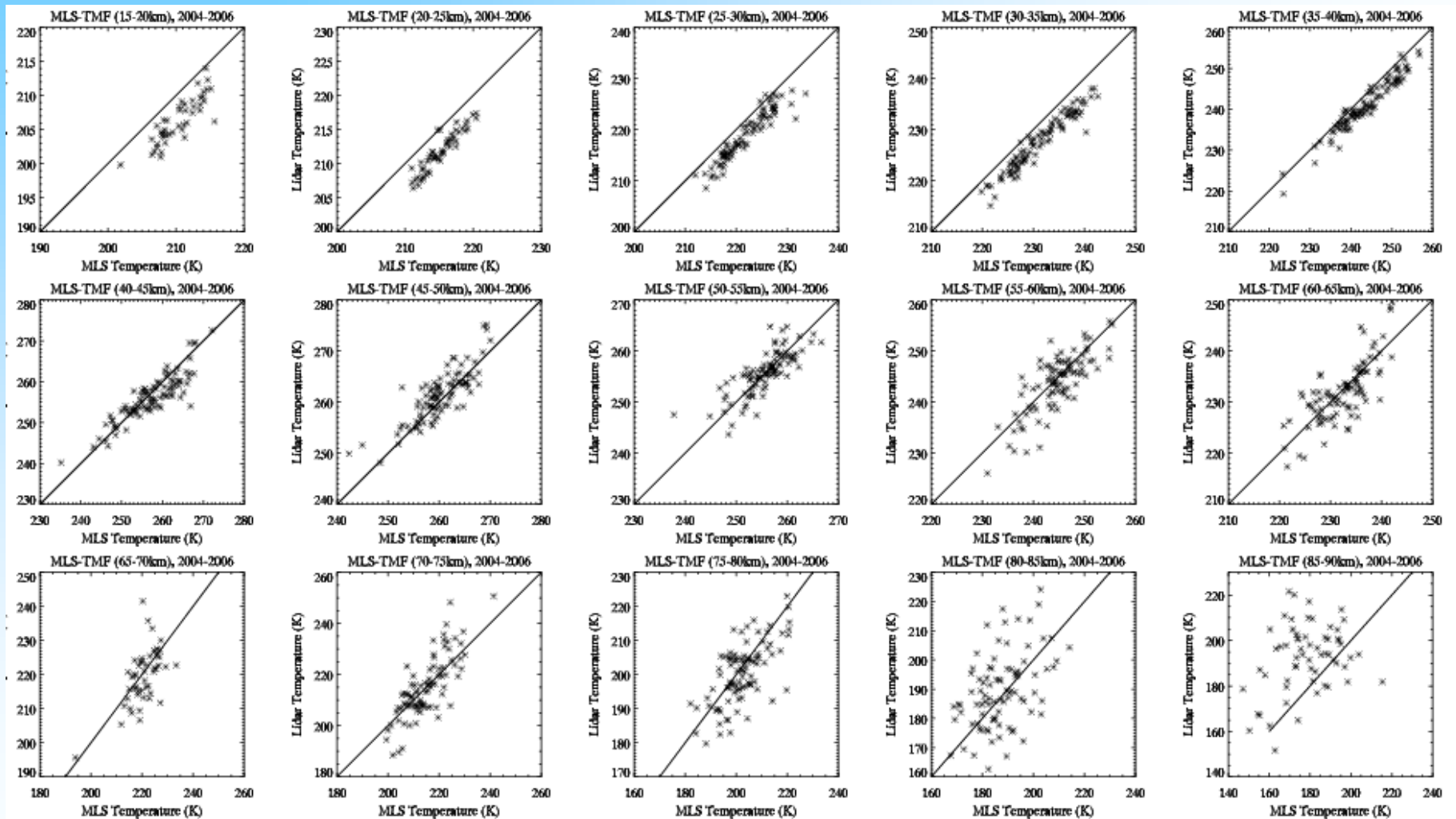
Green: MLS-lidar (individual)
Black: MLS-lidar (mean)

Red and blue solid: Standard deviations
Red and blue dotted: Precisions



1. TMF lidar systematically 2 K colder than MLS in the stratosphere
2. Excellent agreement between 2 hPa and 0.07 hPa
3. Large Warm lidar bias in upper mesosphere

Comparisons MLS - TMF lidar (temperature)

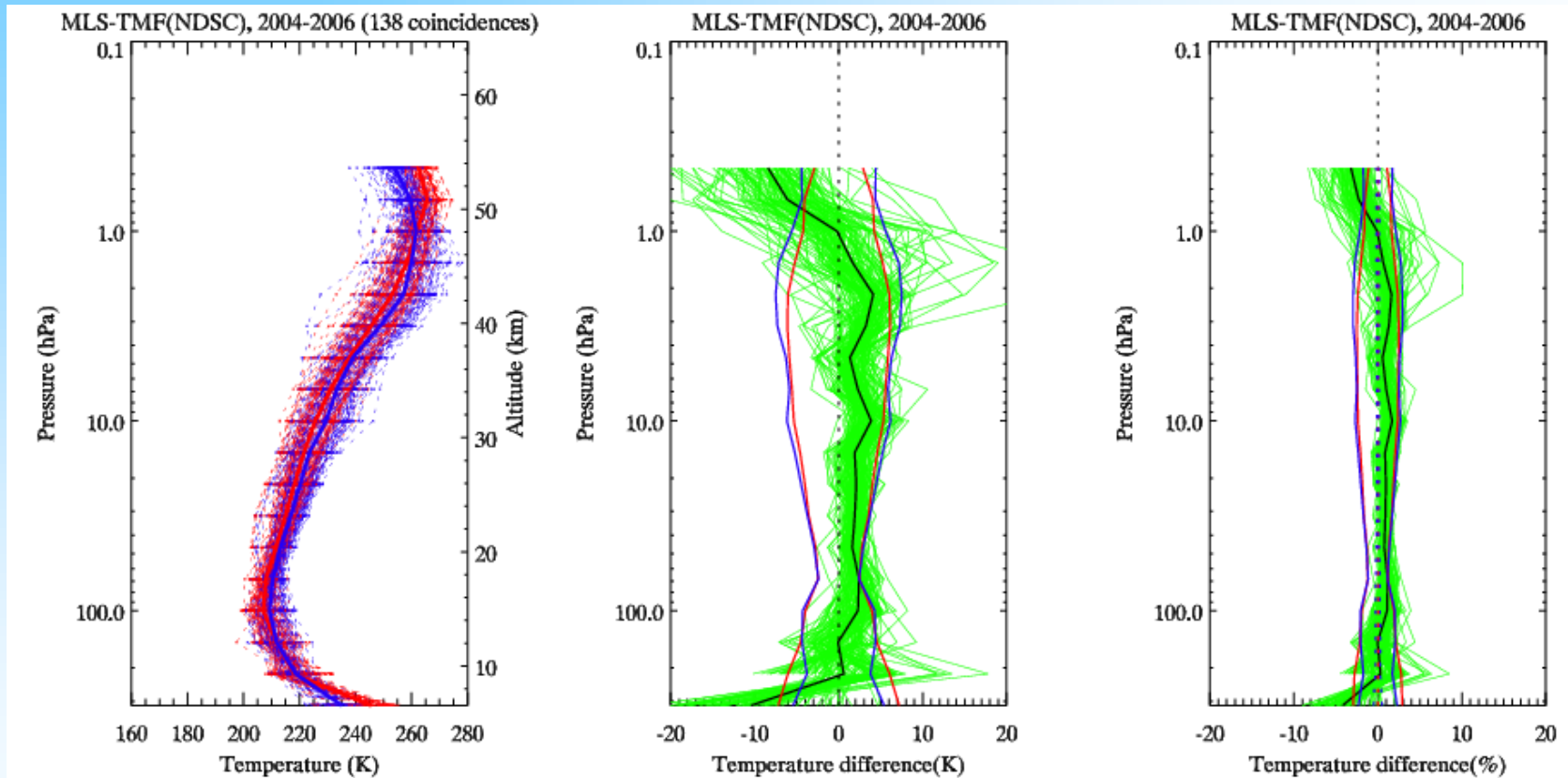


MLS – NCEP operational analysis at TMF

Blue: MLS
Red: NCEP

Green: MLS-lidar (individual)
Black: MLS-lidar (mean)

Red and blue solid: Standard deviations
Red and blue dotted: Precisions



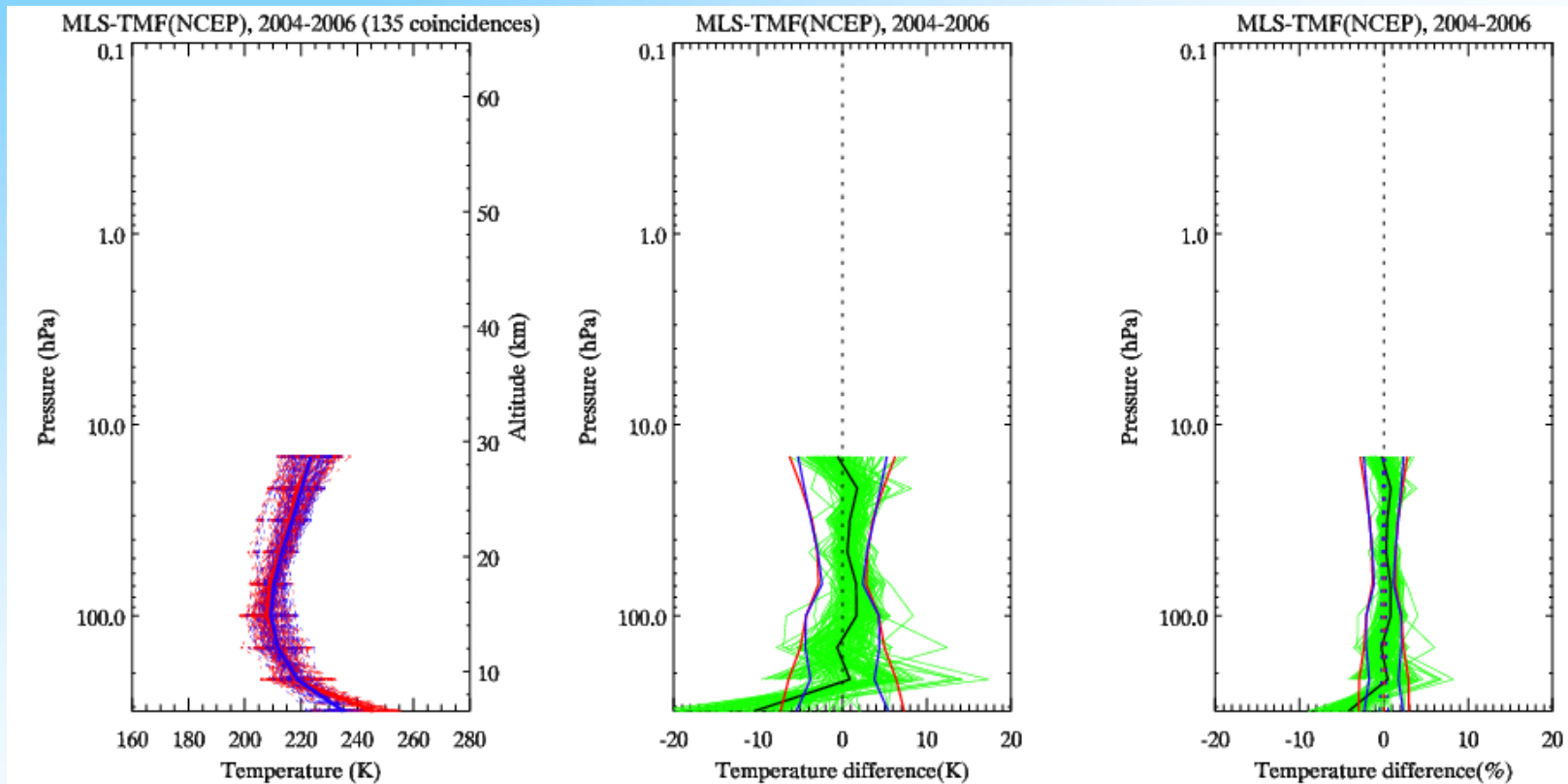
1. **MLS systematically warmer than NCEP in the stratosphere**
2. **Systematic bias decrease if MLS profile shifted up (2-3% pressure)**

MLS – NCEP/NCAR Re-Analysis at TMF

Blue: MLS
Red: NCEP

Green: MLS-lidar (individual)
Black: MLS-lidar (mean)

Red and blue solid: Standard deviations
Red and blue dotted: Precisions



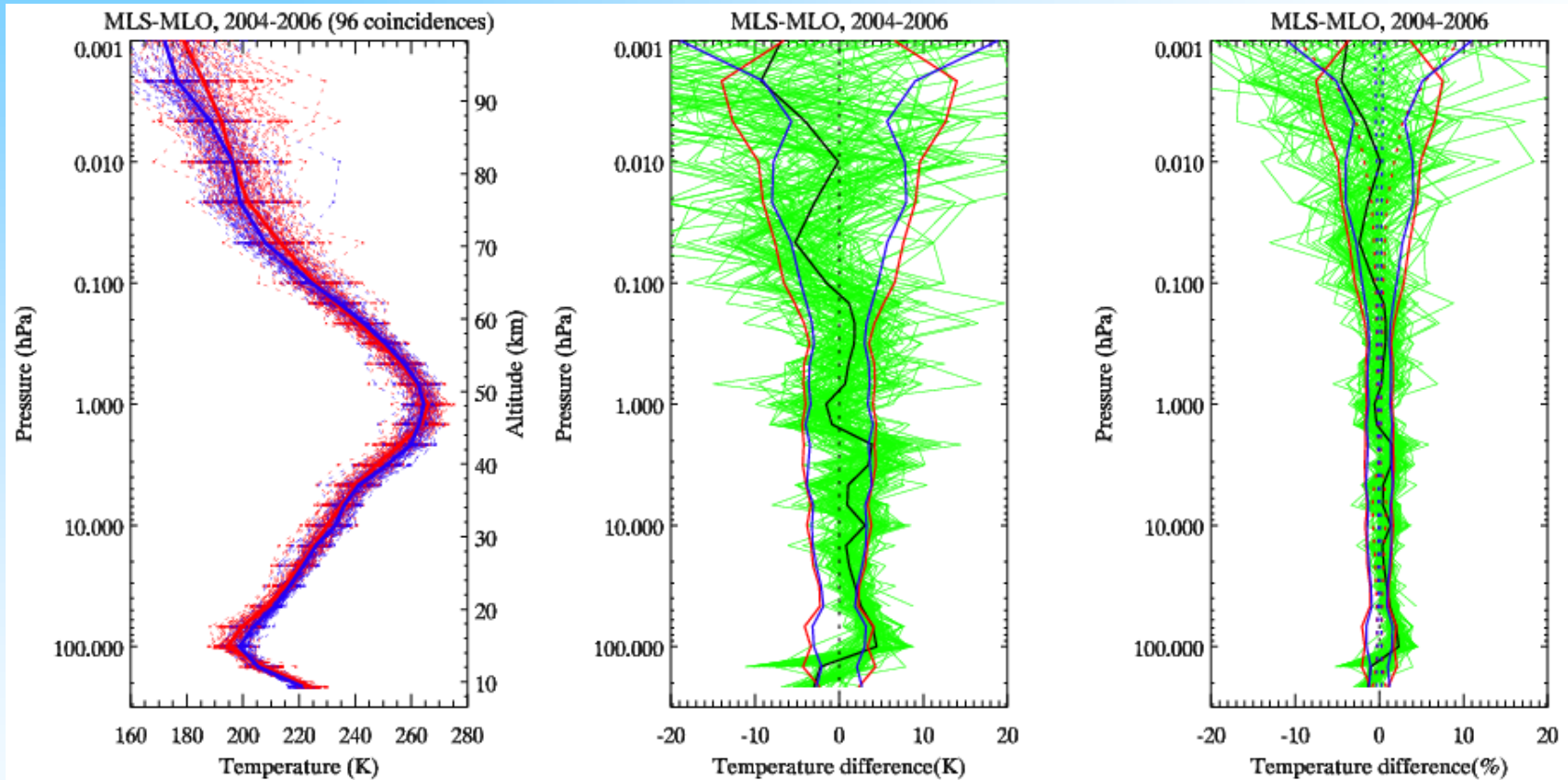
1. **MLS 1-2 K warmer than NCEP/NCAR re-analysis in the stratosphere**
2. **MLS colder than NCEP/NCAR re-analysis in the upper troposphere**
3. **Systematic bias is reduced if MLS shifted up (2-3% pressure)**

MLS – Mauna Loa lidar (within +/- 6 hours and 400 km)

Blue: MLS
Red: lidar

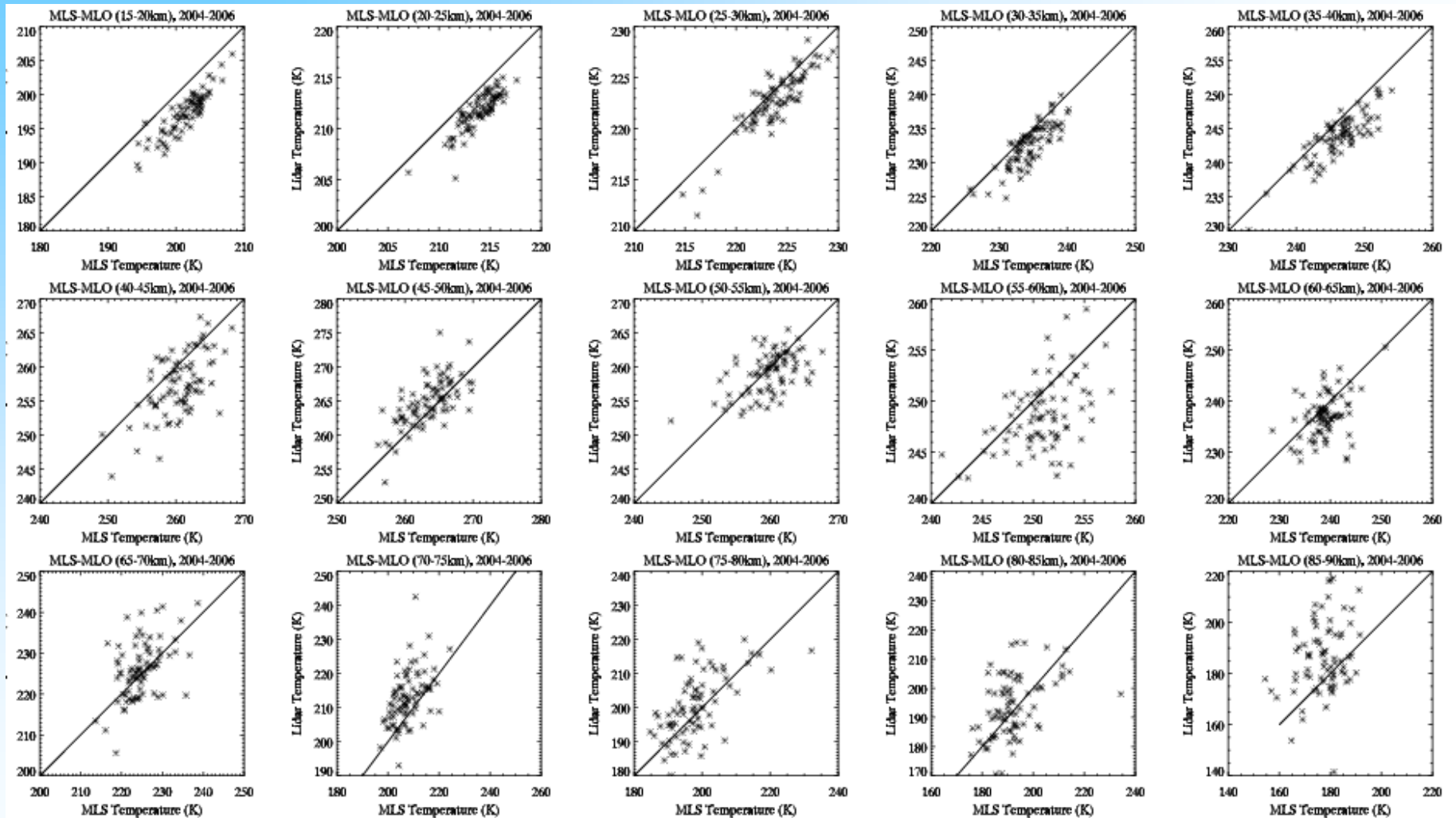
Green: MLS-lidar (individual)
Black: MLS-lidar (mean)

Red and blue solid: Standard deviations
Red and blue dotted: Precisions



1. MLO lidar systematically 1-2 K colder than MLS in the stratosphere
2. MLO lidar systematically 1-4 K warmer than MLS in the mesosphere
3. Large warm lidar bias in upper mesosphere

Comparisons MLS - MLO lidar (temperature)

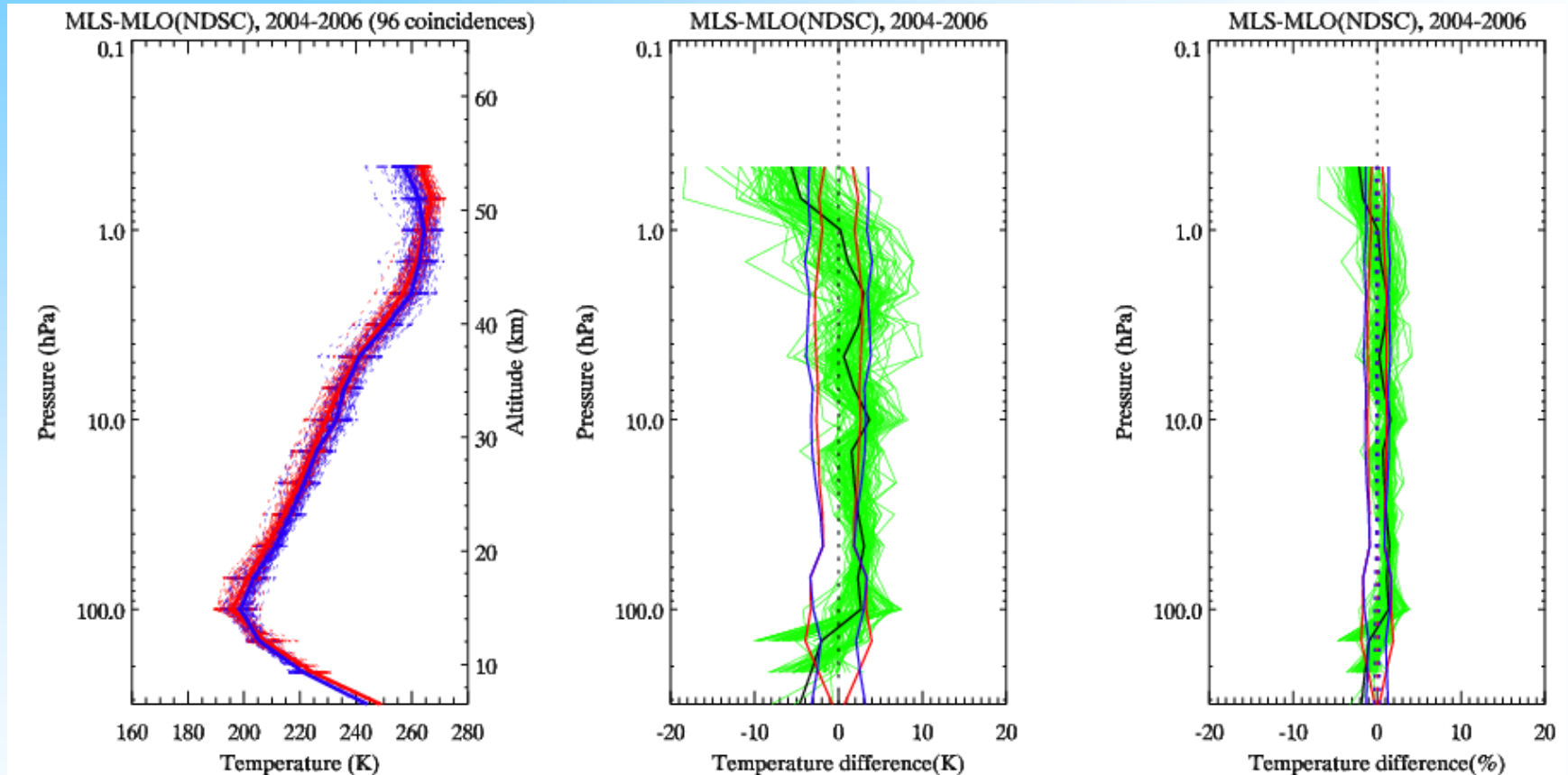


MLS – NCEP operational analysis at MLO

Blue: MLS
Red: NCEP

Green: MLS-lidar (individual)
Black: MLS-lidar (mean)

Red and blue solid: Standard deviations
Red and blue dotted: Precisions



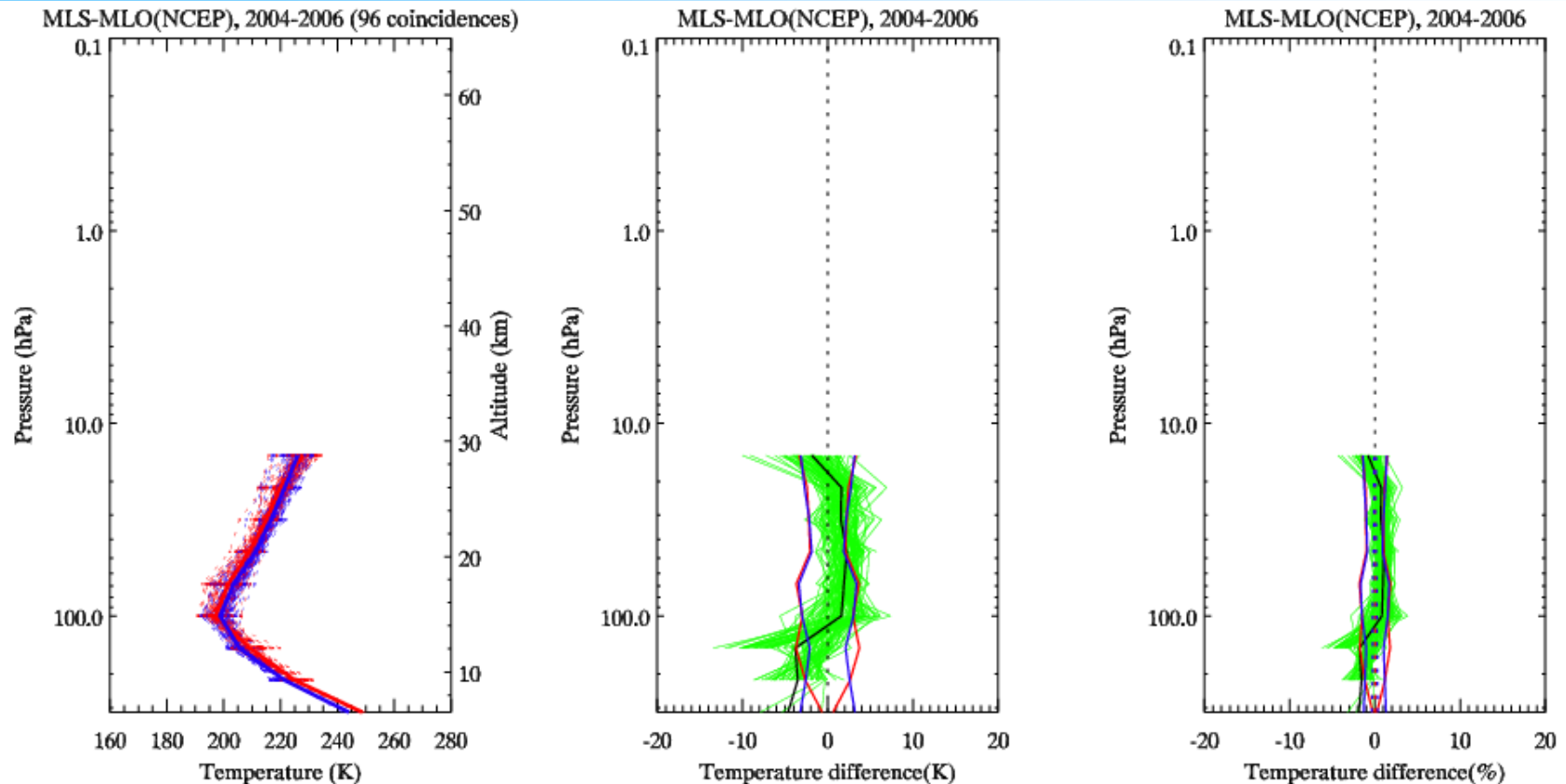
1. **MLS systematically warmer than NCEP in the stratosphere**
2. **Systematic bias decrease if MLS profile shifted up (2-3% pressure)**

MLS – NCEP/NCAR Re-Analysis at MLO

Blue: MLS
Red: NCEP

Green: MLS-lidar (individual)
Black: MLS-lidar (mean)

Red and blue solid: Standard deviations
Red and blue dotted: Precisions



1. **MLS 1-2 K warmer than NCEP/NCAR re-analysis in the stratosphere**
2. **MLS colder than NCEP/NCAR re-analysis in the upper troposphere**
3. **Systematic bias is reduced if MLS shifted up (2-3% pressure)**

MLS – Hilo Radiosondes (60 km east of Mauna Loa)

Blue: MLS

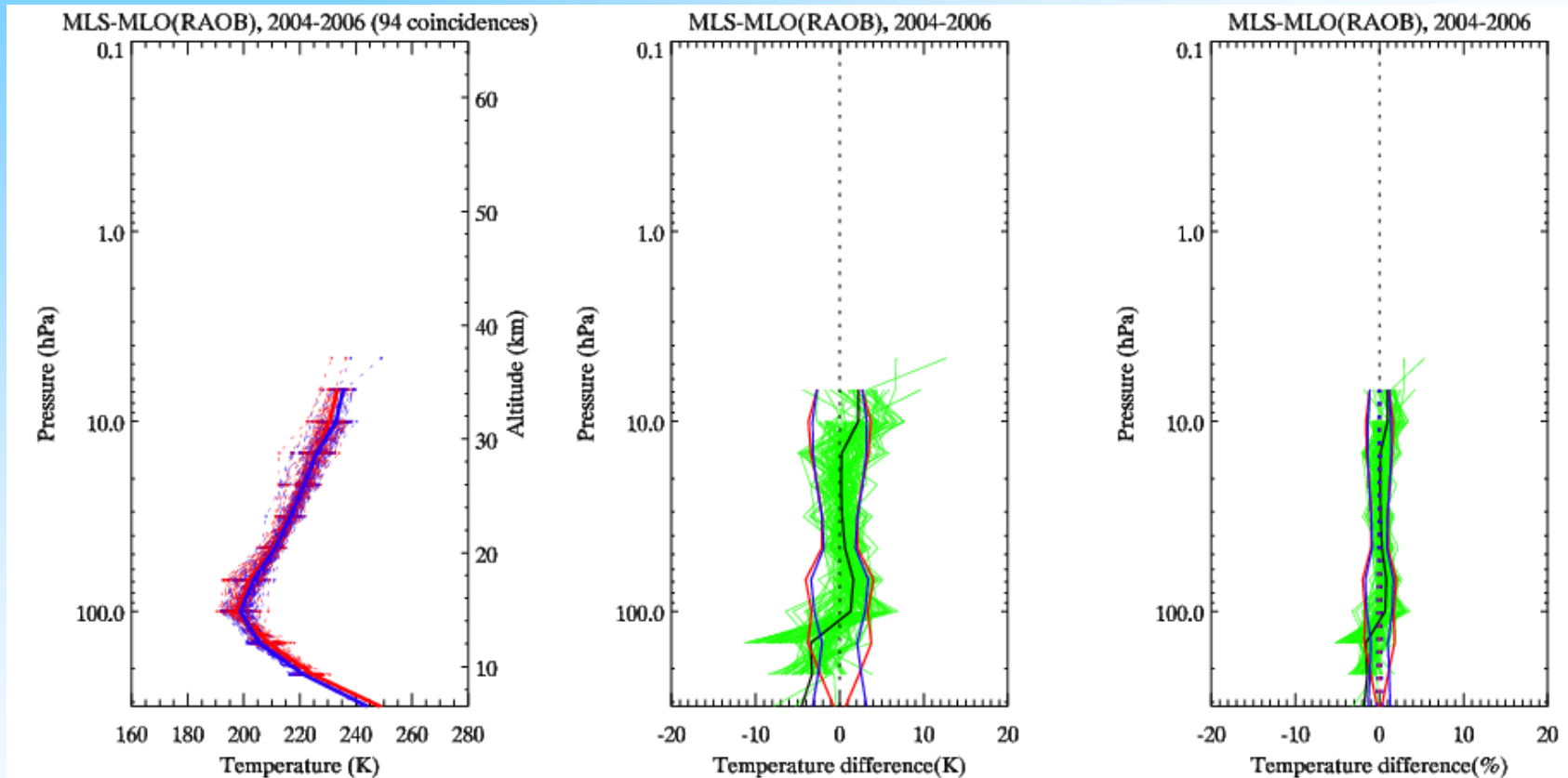
Green: MLS-lidar (individual)

Red and blue solid: Standard deviations

Red: RadioSonde

Black: MLS-lidar (mean)

Red and blue dotted: Precisions



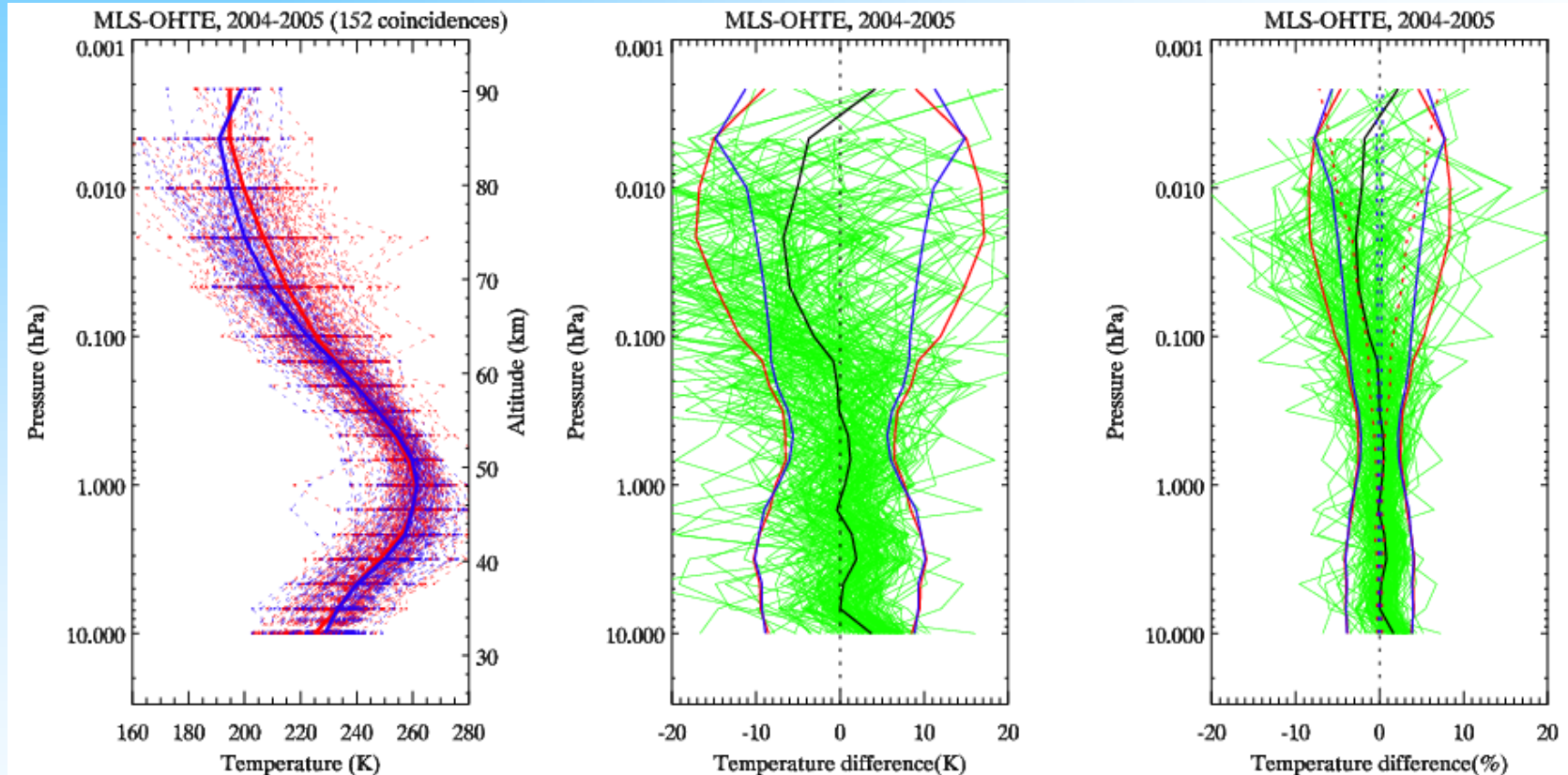
1. **MLS 1-2 K warmer than radiosondes in the lower stratosphere**
2. **MLS colder than radiosondes in the upper troposphere**
3. **Systematic bias is reduced if MLS shifted up (2-3% pressure)**

MLS – Haute-Provence (France) lidar (within +/- 6 hours and 400 km)

Blue: MLS
Red: lidar

Green: MLS-lidar (individual)
Black: MLS-lidar (mean)

Red and blue solid: Standard deviations
Red and blue dotted: Precisions



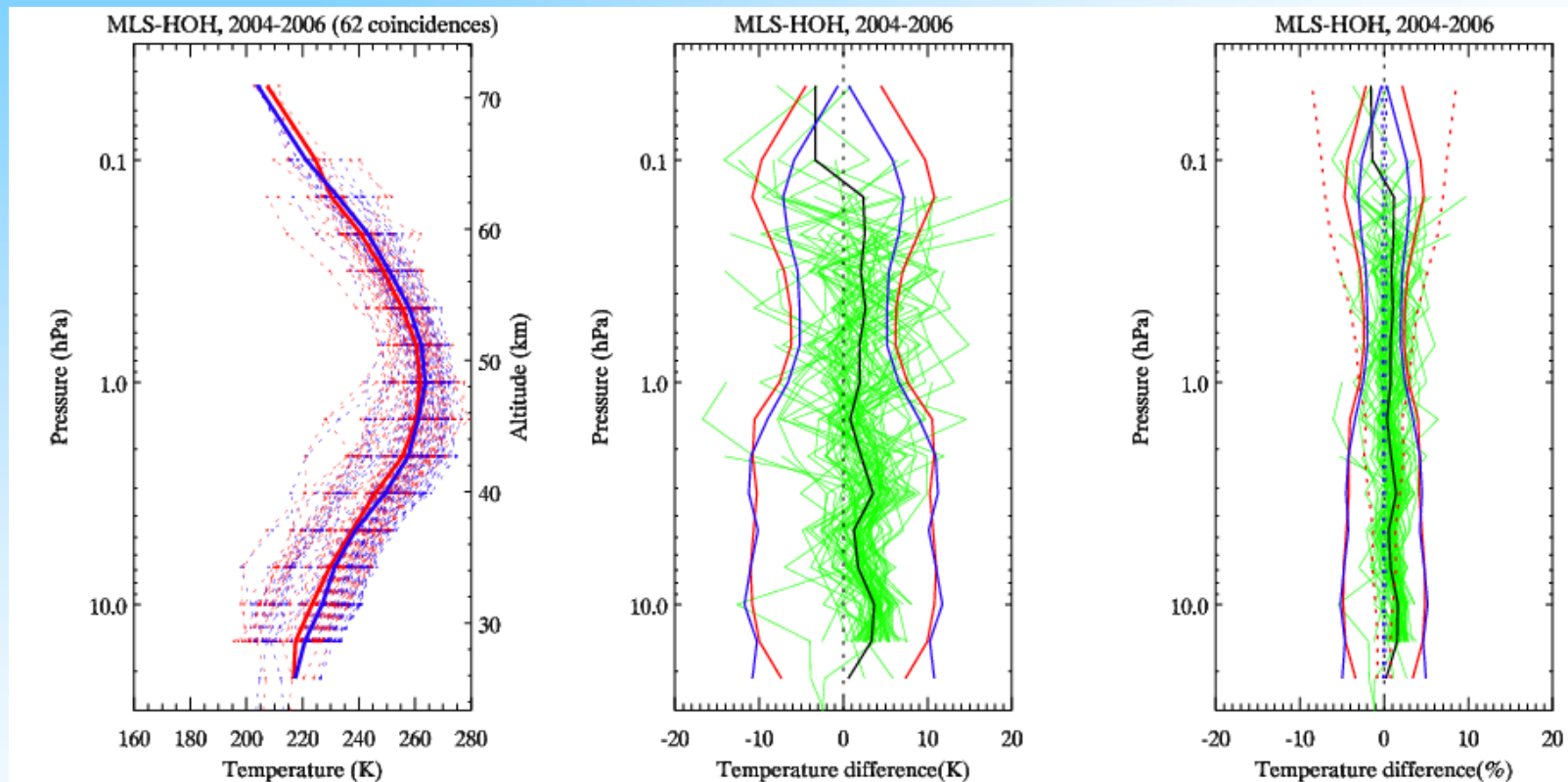
1. OHP lidar systematically 1-2 K colder than MLS in the stratosphere
2. OHP lidar 2-4 K warmer than MLS in the mesosphere
3. Bias reduced if MLS profiles shifted up (2-3% pressure)

MLS – Hohenpeissenberg (Germany) lidar (within +/- 6 hours and 400 km)

Blue: MLS
Red: lidar

Green: MLS-lidar (individual)
Black: MLS-lidar (mean)

Red and blue solid: Standard deviations
Red and blue dotted: Precisions



1. HOH lidar systematically 1-2 K colder than MLS in the stratosphere
2. OHP lidar 3 K warmer than MLS in lower mesosphere
3. Bias reduced if MLS profiles shifted up (2-3% pressure)

MLS – Ny-Alesund (Spitzbergen) lidar (within +/- 6 hours and 400 km)

Blue: MLS

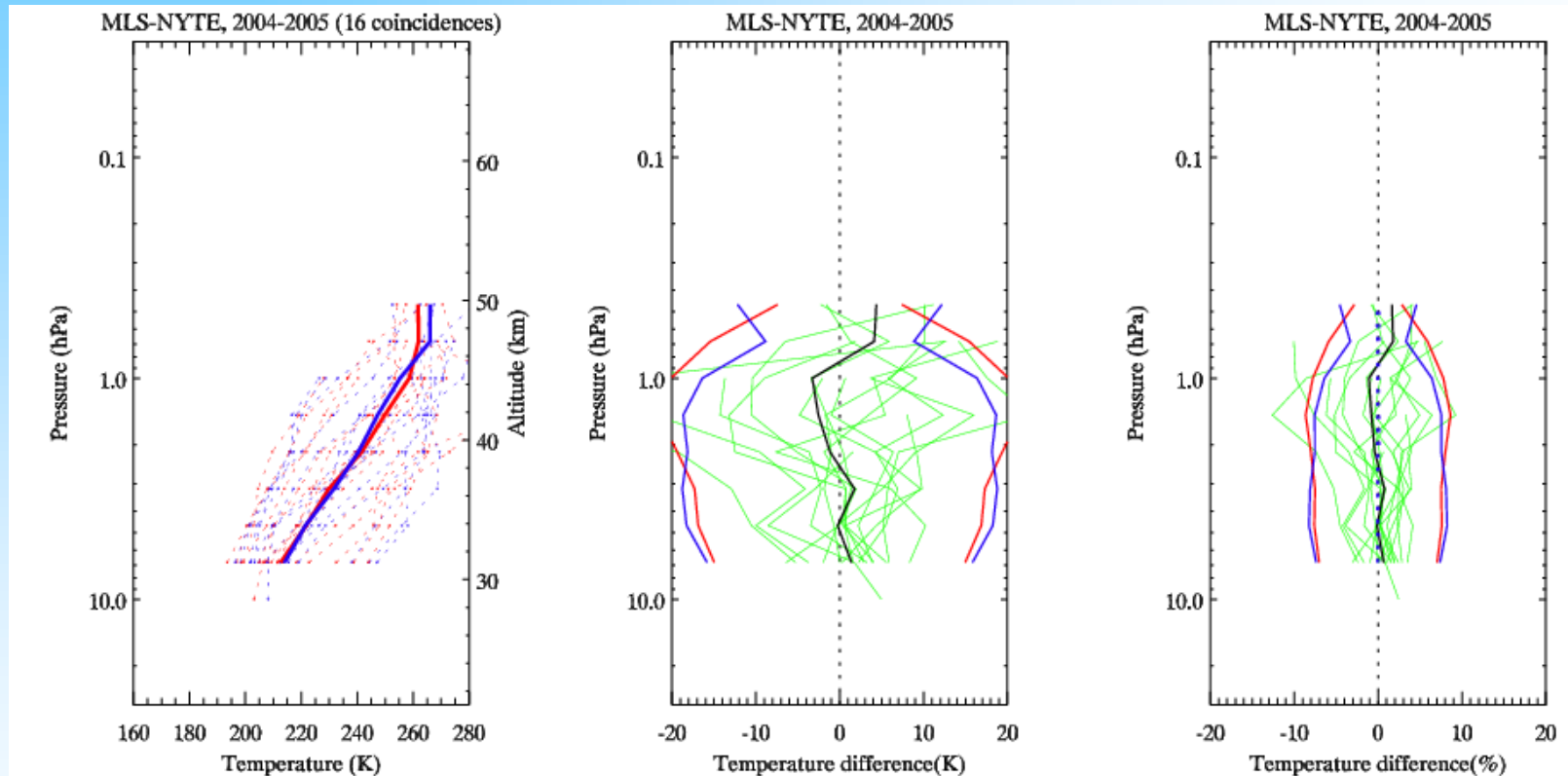
Green: MLS-lidar (individual)

Red and blue solid: Standard deviations

Red: lidar

Black: MLS-lidar (mean)

Red and blue dotted: Precisions



1. Differences remain well below uncertainties and natural variability
2. Poor statistics
3. New version and updated lidar temperature dataset expected shortly

Conclusion

All comparisons shown here seem to point towards a well defined pattern of systematic biases:

- 1. MLS v5.1 seems to be 1-3 K too warm in the stratosphere, 1-2 K too cold in the upper troposphere and 2-4 K too cold in the mesosphere**
- 2. Observed biases are consistent with a slightly offset pressure registration (MLS shifted down?).**
- 3. An upward shift of the MLS profiles (2-3% in pressure) reduces significantly the observed differences with all other instruments and models.**

Future plans:

- Use new MLS version 2 !**
- Extend comparisons to TES and HIRDLS datasets when available**
- Extend Aura-to-model comparisons to the entire globe, and to both NCEP and ECMWF models**